

V. *A Way for Myopes to use Telescopes without Eye-Glasses, an Object-Glass alone becoming as useful to them, and sometimes more than a Combination of Glasses. Communicated to the Royal-Society, by the Reverend J. T. Desaguliers, LL. D. and F. R. S.*

Lemma I:

WHat is requir'd of a Telescope is to give large, and distinct Vision; that is, to make the Object (as in *Galileo's* Telescope) or its Image (as in the Telescopes made up of Convex *Lentes*) appear under a great Angle, and to have all the Rays of those Pencils that enter the Eye, meet in a point upon the *Retina* of the Eye, on their respective Axes.

The first Figure represents the Combination of two Convex *Lentes* for the Astronomical or inverting Telescope; where the above-mentioned Requisites are obtain'd. A B is the Object suppos'd at a vast distance from the Objective *Lens* LL, so that Rays coming from the extremity A of the Object, will fall upon the *Lens* LL, in the same manner as if they were parallel to their Axis AX; and after passing the Glass unite at *a*, where they project the Image of the Point A; from whence diverging, they fall on the Eye-Glass ll, and having pass'd through it, go on parallel to each other, and enter the *Cornea* of a common Eye E, which unites those parallel Rays upon its *Retina* R R R at *a*, where the Image of *a* is projected: The same may be said of the Rays that come from B, and after their

their several refractions through the two Glasses and the Coats and Humours of the Eye, meet upon the *Retina* at β , where they project the distinct Image of the Point b . The Rays that come from all the Points of the Object AB being affected after the same manner, give a distinct Image of those Points upon the *Retina*, and therefore the Object does appear distinct.

The Object will also appear magnified in the same proportion as the Angle $\angle C l =$ to $\angle M a$ (under which its Image is seen,) is greater than the Angle $\angle A C B$ under which the Object AB would be seen by the naked Eye; as is more at large demonstrated by Dioptrical Writers.

Lemma 2.

If parallel Rays fall upon the *Cornea* of a *Myops*, or short-sighted Person, they will unite in the Eye, before they come to the *Retina*, the farther from it the more Convex the Eye is; but if the Rays which fall upon the *Cornea* diverge in proportion to the too great Convexity of the Eye, as from D , such Rays will be so refracted by the Coats and Humours of the Eye as to meet in one point upon the *Retina* RR , see *Fig. 2* and *3*. Where I have in the Scheme neglected the Refraction of the Rays passing out of the *CrySTALLINE* K into the *Vitreous* Humour V , as I do in the other Cases.

This *Lemma* is also demonstrated by Dioptrical Writers.

Lemma 3.

If two Pencils of Rays (in each whereof all the Rays are parallel to the Axis, as $a C$) fall upon different Parts of the *Cornea*, at the greatest distance from one another that can be allow'd for those Rays to enter the Pupil PP , their *Axes* will, after entering the

Aqueous

Aqueous Humour, converge, and meet either in the *Vitreous*, or *Crystalline Humour*, according to the *Convexity* of the *Cornea* thro' which they pass'd, and diverge again before they come to the *Retina*; the Rays of each Pencil converging upon their respective Axes, to the place where the said Axes cross one another, *Fig. 4.*

Demonstration.

The Axes aCa , $\alpha C\alpha$, falling obliquely upon the *Cornea* at C, C , and entring from *Air* into the *Aqueous Humour*, will be refracted towards the Perpendicular to K : where striking more directly upon the *Crystalline*, they will go on to α, a , upon the *Retina* $RRRR$, decussating at V within the *Vitreous Humour*. The other Rays r, r ; p, p , after their Refraction in the *Aqueous Humour*, fall more obliquely on the *Crystalline*, and therefore are refracted again so as to meet at V , where the Axes also meet, and thence go on to the *Retina* $RRRR$, *Fig. 4.*

Lemma 4.

But if the Axes of the above-mention'd Pencils are Parallel, the Rays that accompany them diverging from a Point so near the Eye, that the divergence may be proportionable to the too great Convexity of the Eye; then only the Axes will meet in the Eye before they come to the *Retina* (by *Lemma 3.*) but the other Rays will not unite upon their respective Axes, till they come to the *Retina*, (by *Lemma 2.*)

Proposition.

I suppose the Eye of the *Myops* so Convex that he can see no farther than a common Eye, with the Eye-Glass of a Telescope before it: then the Eye of the

Myops being in the place of the Eye-Glass, will receive the Rays diverging from the several points of the Image (projected by the Object-Glass in its *Focus*,) in such manner, that they will after their several refractions meet in respective Points on the *Retina*; and the Axes of the Pencils which come from the extremities of the Object, will, in the Eye, make the Angle $BVA =$ to bca , under which the Image ab is seen, by *Lemma 4*. The *Cornea* and *Aqueous Humour* here supply the place of the Eye-Glass, and the *CrySTALLINE* and *Vitreous* Humours that of a common Eye, See the 5th *Fig.* wherein *R* is the *Retina*, *V* the *Vitreous* Humour, and *KK* the *CrySTALLINE* Humour; and the Image ba is suppos'd to be brought down from the *first Fig.* which represents the *Astronomick Telescope*: the too great Convexity of the Eye here being in the place of an Eye-Glass.

An Objection may be made to this, *viz.* that *PP* the Pupil of the Eye being small, will take in but a very little Image, or a small part of the Object: But then if the Eye be mov'd successively, to all the parts of the Space where the Eye-Glass was, it can take any part of the Object; and if the Object-Glass be large, which may more easily be made than a large Eye-Glass, and the Tube a Foot wide or wider, as much may successively be taken in, as if an Eye-Glass might be had of a Foot Diameter. A little practice may make any *Myops* so ready, as to keep an Object when once found, though the place where he stands be shaken. It would not be amiss to hold a *Lens* in one's Hand (for an Eye-Glass) to find the Object at first, till custom has made it easy without it: when once the Object is found, it may be easily kept.

An Eye more short-sighted than I have suppos'd, will perform the Office of a more Convex Eye-Glass, being

being brought nearer to the distinct Base of the Object Glass; and an Eye less Convex, the office of a less Convex Eye-Glass: but with this difference, that the more Convex the Eye is, the easier may any part of the Object be found, and the larger and more lucid it will appear.

I have seen *Saturn's* Ring very plain with an Object-Glass of little more than six Foot *Radius*, without an Eye-Glass.

I have also found out a way for the *Presbyta* to make use of an Object-Glass, by placing their Eye nearer the *Lens* than its *Focus*, by so much as their Eye is flatter than a common Eye, so as to make (as it were) the Telescope of *Galileo*; the flat Eye serving as a common Eye arm'd with a Concave *Lens*. I have so fixed the Telescope, as to make a *Presbyta* read at a great distance a small Print. The truth of this may be easily demonstrated, if it be requir'd.

If this Experiment be made at Sea with a very large Tube, big enough to put in the Head and move it about, and the Object-Glass be also large, it may not perhaps be difficult to observe the Eclipses of the *Satellites* of *Jupiter*, which I would recommend to the Consideration of those that would try for the Longitude by such like Observations.

VI. *New and accurate Tables for the ready Computing of the Eclipses of the first Satellite of Jupiter, by Addition only.* By the Reverend Mr James Pound, R. S. S.

IN Numb. 214. of these *Transactions*, for the Months of *Novem* and *Decem.* 1694. we exhibited an Epitomy of Mr. *Cassini's* curious Tables then newly published.

